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(56) Documents Cited
GB 1001683 A US 4323620 A

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(54) Fire barrier of the flexible type

(57) A flexible fire barrier comprises alternating metallic layers (16) and layers of fibre glass (18). Each metallic layer comprises at least one layer of metallic foil. The fibre glass layers have a thickness of 0.5 to 5mm and a density of 20 to 200 kg/m^3 when uncompressed, and the metallic foil forming the metallic layers has a thickness of at least 20 micrometres. The ratio of the total foil thickness to the total thickness of the fibre glass layers is greater than 6×10^{-3}.

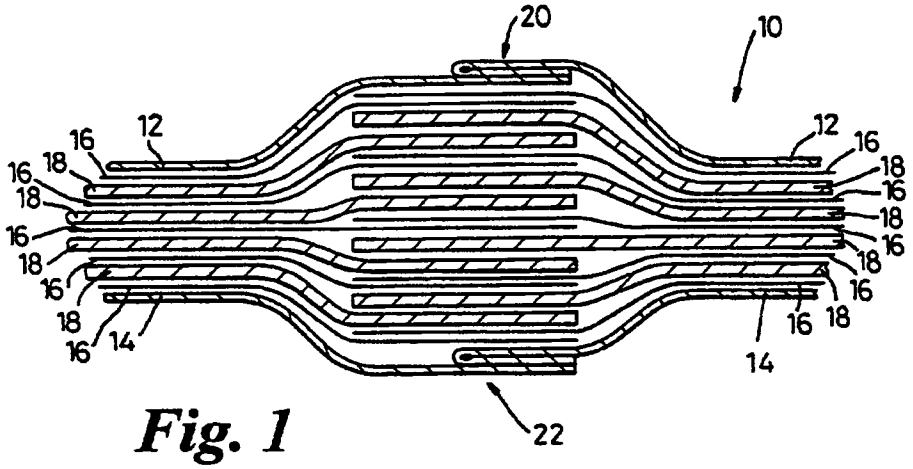

Fig. 1

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

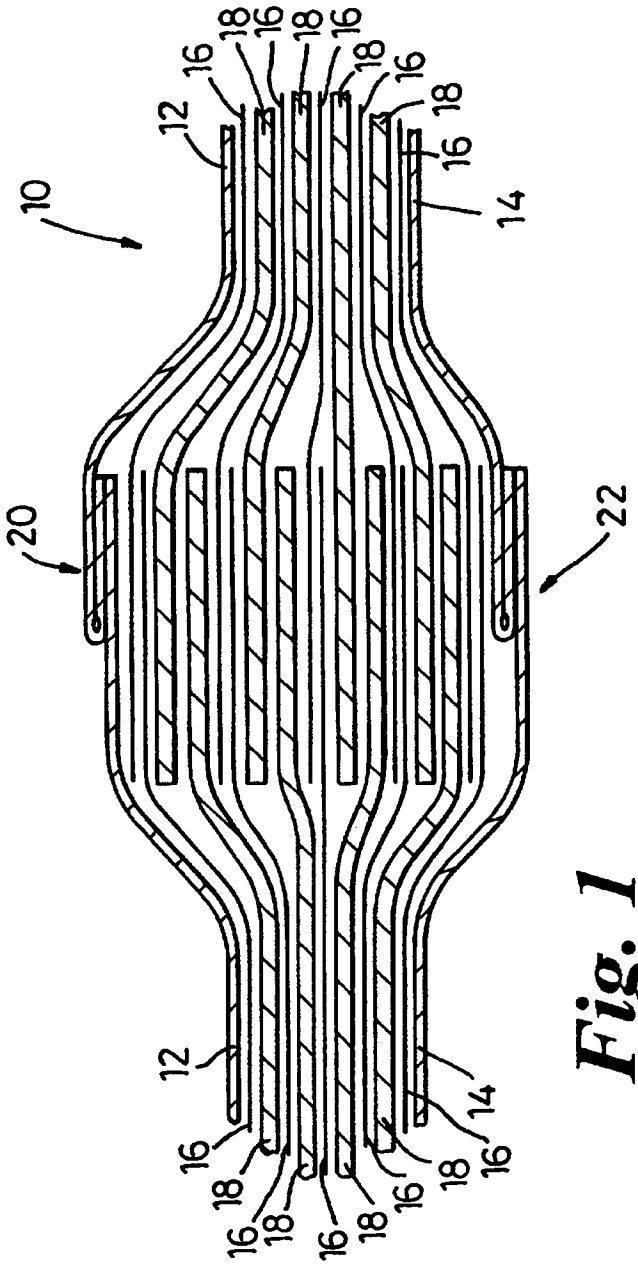

Fig. 1

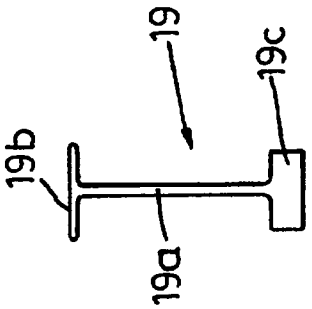

Fig. 2

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FIRE BARRIERS OF THE FLEXIBLE TYPE

This invention is concerned with fire barriers of the flexible type.

Flexible fire barriers are used for retarding the spread of fire through spaces where it is not practical or desirable to build dividing walls. For example, the roof space of a building may be sub-divided by such barriers. Such barriers need to resist penetration by a fire and provide heat insulation. Typically, the barrier is suspended from a frame, to which it is attached by mechanical fasteners, and hangs down like a curtain to the floor of the space. Such barriers are supplied in sheet form, eg in a roll, having a limited width which is often narrower than the space to be sub-divided. In this case, a number of lengths are hung side-by-side with abutting edges to form the barrier. A joint has to be formed at such abutting edges in order to avoid a gap through which fire or gases could spread.

Conventional flexible fire barriers are made of mats formed from fibres, the fibres being made of glass, mineral wool, or other heat-resistant materials. In order to meet the required insulation properties, these mats have to be thick (up to 50mm) making the barriers difficult to install because of their weight and low flexibility. It is also difficult to form joints between lengths of such barriers. It has been recognised that the thickness of such barriers can be reduced, while still retaining their insulation properties, by incorporating one or more layers of metallic foil in the barrier. Examples are described in WO 90/09281 and in GB 1 583 744.

WO 90/09281 describes a fire barrier material which comprises at least one layer of glass fibre formed into a knitted fabric which is 8mm in thickness. The barrier also

comprises two layers of woven glass fibre fabric positioned on opposite sides of the knitted fabric and separated therefrom by layers of metallic foil about 15 micrometres in thickness. The foil layers are attached to the woven layers. GB 1 583 744 describes two layers of heat-resistant fibrous material which are each 25mm in thickness. These layers have a layer of foil between them. These proposals result in barriers which are still undesirably thick.

It is an object of the present invention to provide a flexible fire barrier which can be thinner than previous proposals while retaining the required protective properties.

The invention provides a flexible fire barrier comprising alternating metallic layers and layers of fibre glass, each metallic layer comprising at least one sheet of metallic foil, wherein the fibre glass layers have a thickness of 0.5 to 5mm and a density of 20 to 200 kg/m^3 when uncompressed, and the metallic foil forming the metallic layers has a thickness of at least 20 micrometres, the ratio of the total foil thickness to the total thickness of the fibre glass layers being greater than 6×10^{-3}.

It is found that the combination of thin glass fibre layers of the specified density with layers of relatively thick metallic foil gives excellent protective properties at low overall thickness provided that the specified ratio is satisfied. In some cases, the overall thickness can be reduced to about 5mm.

It is found that optimum results are achieved if said ratio is greater than 30×10^{-3}.

It is found that the thickness of the barrier can be minimised if the ratio of the product of the total thickness of the fibre glass layers and the total thickness of the metallic layers to the density of the fibre glass layers is greater than 300 x 10^{-12} $m^2/kg/m^3$, preferably greater than 1000 x 10^{-12} $m^2/kg/m^3$.

A fire barrier according to the invention should have at least two layers of fibre glass and at least three metallic layers.

Preferably, the fibre glass layers have a thickness of 1 to 2 mm and their density is preferably 30 to 100 kg/m^3.

Preferably, a barrier according to the invention also comprises two outer layers formed from heat-resistant woven cloth. This material may be E-glass fibre treated to improve its heat-resistance, eg by chemical coating (for example with fine vermiculite particles), or by acid leaching. The woven textile material should be capable of withstanding at least 800°c.

The metallic foil may be aluminium foil and, preferably, has a thickness of at least 30 micrometres.

Where the barrier comprises a joint between edge portions of two adjacent lengths of the barrier, at the joint, the metallic and fibre glass layers of the adjacent lengths may overlap one another and the outer layers of the adjacent lengths may be joined together. In this way, the outer layers hold the other layers in their overlapped condition. The metallic and fibre glass layers may be interleaved and, if desired, at the joint, the metallic layers of adjacent lengths may be secured together by adhesive.

The layers of the barrier are, preferably, held together by mechanical fastening means which does not compress the fibre glass layers significantly so that their insulating properties are not unduly reduced. Preferably, the fastening means is sacrificial in the event of fire so that any compression of the fibre glass layers is removed and potential heat conduction paths through the barrier are removed. Suitable mechanical fastening means is stitching made of polypropylene which melts in a fire. Alternatively, thin plastics "rivets" may be used, eg those supplied as labelling tags by Dennison International of Farmington, Massachusetts, under the Tradename "Ezi Tag".

There now follows a detailed description, to be read with reference to the accompanying drawings, of a flexible fire barrier which is illustrative of the invention.

In the drawings:

Figure 1 is a diagrammatic horizontal cross-section taken through two lengths of the illustrative fire barrier, showing a joint between the lengths; and

Figure 2 is a side elevational view of a fastener used in the illustrative fire barrier.

The illustrative fire barrier 10 comprises two outer layers 12 and 14 which are formed from woven cloth made of heat-resistant material, specifically E-glass which has been chemically coated to increase its heat resistance. The layers 12 and 14 are formed from continuous fibres which are more than 3 micrometres in diameter. The woven glass cloth is 0.4 mm thick and weighs 400gms/m^2. The woven glass cloth is available from TBA Industrial Products Limited of Rochdale England under the tradename "FireFly EKO 401".

The fire barrier 10 also comprises alternating layers of aluminium foil 16 and fibre glass 18. Specifically,

there are five layers of aluminium foil 16 each of which consists of a single sheet which is 50 micrometres thick and there are four layers of fibre glass 18 each of which is in the form of a non-woven tissue 1 mm in thickness made from fibres having a diameter greater than 3 micrometres. The non-woven glass fibre tissue has a density of 75 kg/m^3 and is available from Fibrmat Limited. The layers of aluminium foil 16 and fibre glass tissue 18 are positioned between the woven outer layers 12 and 14.

The fire barrier 10 is held together (loosely so as not to compress the fibre glass layers) by fasteners 19 made of polypropylene. One of the fasteners 19 is shown in Figure 2. The fastener 19 is of the type commonly used for clothes labelling. It comprises a cylindrical shank 19a which passes through the barrier 10, a head 19b at one end of the shank 19a, and a head 19c at the other end thereof. The head 19b is in the form of a cylindrical bar which forms a T-shape with the shank 19a. The head 19b is designed to be deformed to the shape of an arrow head which can be forced through the layers 12, 14, 16 and 18 and then returns to its undeformed shape. The head 19c is in the form of a rectangle. The fastener 19 holds the layers 12, 14, 16 and 18 together relatively-loosely in order to avoid compressing the layers 18 which might reduce their insulating properties. The fastener 19 is designed to melt in the event of fire releasing any compression of the layers 18. The fasteners 19 are not shown in Figure 1 as they are positioned away from the edges of the lengths of the barrier 10 so that they do not obstruct joint formation. The overall thickness of the fire barrier 10 is 5mm.

In the fire barrier 10, the ratio of the total foil 16 thickness to the total thickness of the fibre glass layers 18 is 63×10^{-3}. The ratio of the product of the total thickness of the fibre glass layers 18 and the total

thickness of the aluminium layers 16 to the density of the fibre glass layers 18 is 1330 x 10^{-12} $m^2/kg/m^3$.

Figure 1 also illustrates a joint between edge portions of adjacent lengths of the fire barrier 10. At the joint, edge portions of the layers 16 and 18 of said adjacent lengths overlap one another. Specifically, the layers 16 and 18 of the two lengths are interleaved. Furthermore, at the joint, the outer layers 12 and 14 of the adjacent lengths are joined together to hold the layers 16 and 18 in their overlapping condition.

To make the joint shown in Figure 1, an installer first bends edge portions of the outer layers 12 of the two lengths towards himself. He then joins these edge portions together, eg by staples, and folds them over to lie parallel to the layers 12. This creates the seam 20 shown in Figure 1. In order that the installer can work from one side only of the barrier, the seam 20 is made facing the installer and towards the centre of the barrier. Next, the installer interleaves the layers 16 and 18 of the two adjacent lengths of barrier 10. As shown in Figure 1, this interleaving results in each of the foil sheets 16 of one of the lengths contacting a foil sheet 16 of the adjacent length. Similar contacts are also made between the sheets 18 of the adjacent lengths. If desired, one or more of these contacts between the foil sheets 16 can be secured by adhesive. Finally, the installer makes a folded seam 22 between the outer layers 14 in the same way as he made the seam 20. The seam 22 faces the installer and away from the centre of the barrier 10.

The illustrative fire barrier was tested according to British Standard 476 part 22. The time taken to achieve an average temperature rise of 140°C for five fixed thermocouples was 17 minutes (the requirement being 15 minutes) and the time for any thermocouple to register a

rise of 180°C was 18 minutes (the requirement being 15 minutes). For comparison purposes, a fire barrier consisting of mineral wool having a density of 100 kg/m^3 and a thickness of 50mm was subjected to the same test. The average time for a temperature rise of 140°C was 14.5 minutes and the individual rise of 180°C was recorded after 8 minutes.

CLAIMS

1 A flexible fire barrier comprising alternating metallic layers and layers of fibre glass, each metallic layer comprising at least one sheet of metallic foil, wherein the fibre glass layers have a thickness of 0.5 to 5mm and a density of 20 to 200 kg/m^3 when uncompressed, and the metallic foil forming the metallic layers has a thickness of at least 20 micrometres, the ratio of the total foil thickness to the total thickness of the fibre glass layers being greater than 6×10^{-3}.

2 A fire barrier according to claim 1, wherein said ratio is greater than 30×10^{-3}.

3 A fire barrier according to either one of claims 1 and 2, wherein the ratio of the product of the total thickness of the fibre glass layers and the total thickness of the metallic layers to the density of the fibre glass layers is greater than 300×10^{-12} $m^2/kg/m^3$.

4 A fire barrier according to any one of claims 1 to 3, wherein the fibre glass layers have a thickness of 1 to 2mm.

5 A fire barrier according to any one of claims 1 to 4, wherein the fibre glass layers have a density of 30 to 100 kg/m^3.

6 A fire barrier according to any one of claims 1 to 5, wherein the barrier also comprises two outer layers formed from heat-resistant woven cloth.

7 A fire barrier according to any one of claims 1 to 6, wherein the metallic foil is formed from aluminium and is at least 30 micrometres in thickness.

8 A fire barrier according to any one of claims 1 to 7, wherein the barrier comprises a joint between edge portions of two adjacent lengths of the barrier, at the joint, the metallic and fibre glass layers of the adjacent lengths overlapping one another and the outer layers of the adjacent lengths being joined together.

9 A fire barrier according to claim 8, wherein, at the joint, the metallic layers are secured together by adhesive.

10 A fire barrier substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

The Patent Office

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Application No: GB 9605567.8 **Examiner:** Colin Thompson
Claims searched: 1 to 10 **Date of search:** 6 June 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): A5A (A21,A23,A37); B5N

Int Cl (Ed.6): A62C 2/10,8/06; B32B

Other: Online: WPI, EDOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 1001683 A	(Union Carbide Corp) See especially page 2 line 118 to page 3 line 45	1,3,5
X	US 4323620 A	(Iwabuchi) See especially Claim 1	1,2,4,5

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.